AW Engineering
Box 139, Victor, Idaho 83455
Phone 208-787-2952 Fax 208-787-2957

March 3, 2011

Mr Reg Roberts
P.O. Box 417
Riggs, Idaho, 83422

Re; **Heritage Peaks Subdivision**
FEMA Flood Plain Report

Dear Reg:

We have revised the report and ran the HEC RAS program to answer the questions from Williams Engineering. We have resubmitted the report to Williams and to the Teton County. The County has informed us that we are on their agenda for March 9 at 5:00 pm.

We found from this further study that the 100 year flood plain did at Building site 1 was just under the 100 year flood plain revised data. It did not affect building Site 2. We are showing Building Site 1 as having land above the Base Flood Elevation (BFE) but are not stating that it is an island not included in the 100 year flood plain.

Therefore building site 1 would have to elevated at least one foot above the 100 year BFE and may be required by the finance company or the county to get flood plain insurance To get a small or no flood insurance it will need to be filled to be over one foot above the BFE elevation.

We revised and added data at the County bridge to get the program to run correctly.

The topo map is close to what is on the property but is not real accurate because of the undulating ground especially in the creek bottom areas. We only did topo surveying outside of the property on the county road and two cross sections upstream of State Highway bridge.

Site two on Lot 2 is over 4 feet above the shown BFE and does not appear to have any flood plain issues, as we had expected.

Please call if you have any questions.

Sincerely;

Arnold W Woolstenhulme

FLOOD PLAIN REPORT

Heritage Peaks Subdivision

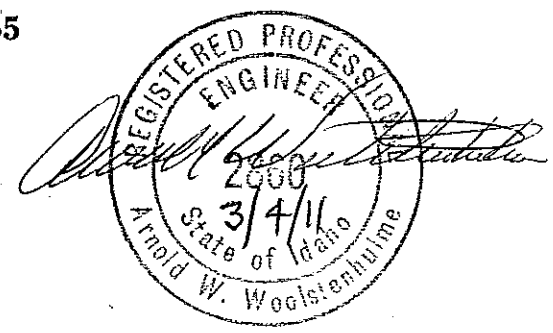
S ½ NW 1/4 Sec 34, Twp 6 N, Rng 45 E, B.M.
Teton County, Idaho

prepared for

D & R Roberts Limited Partnership
P.O. Box 417
Driggs, ID 83422

Revised March 3, 2011

AW ENGINEERING
BOX 139
VICTOR, IDAHO 83455
208-787-2952



INDEX PAGE

HYDROLOGY REPORT

1. SITE DESCRIPTION

The study was conducted on the 18 acres of land on which the proposed Heritage Peaks Subdivision is located, being in the S ½ of the NW 1/4, Section 34, Twp 6 N, Rng 45 E, B.M., Teton County, Idaho.
This study was requested by Teton County Planning and Zoning because of State and Federal rules requiring new subdivisions, having 50 lots or over 5 acres and with flood plain issues will have to have a Flood Plain study. This study is to determine, as a minimum, the Base Flood Elevation (BFE) for each proposed house site. The surveying and study was done by AW Engineering for the Heritage Peaks subdivision on this property in November through December of 2010.

Spring Creek is a creek that is fed by springs, but has the North Fork and Middle Fork of Leigh Creek as a tributary that joins Spring Creek about one mile north of said property. The old historic creek channel appears to have meandered across the said property. The present channel in this property is stable with good vegetation along the banks.

Natural spring runoff for this creek is usually in June of each year. Limited peak flow records exist on this particular stream.
The regression method available online as a computer program at USGS StreamStats of Idaho was run to determine the 100 year flood flow on this property. The point of the junction with Spring Creek and State Highway 33 is the point of flow analysis. This report showed an area of 36.2 Sq miles, and a 100 year flow of 1580 cfs.
See Sheet *C: 1-3 Appendix*

The HEC RAS program shows the calculated velocity and cross sections as it calculated the BFE water surface and shows the water level overtopping the County road and causing back water upstream about 70 feet onto the property. This backwater does not affect either building site. *See sheet D-1 Appendix*

2. Flood Channel

The stream channel upstream is well defined and is channeled into the property by a bridge under State Highway 33. This bridge is 42 feet wide and 6 feet high. Because this bridge is a restriction of creek waters allowed onto this property, it was not placed into the Hec Ras program. The waters in a flood condition that pass through this bridge will be limited to entering onto the property in the channel at the bridge site. Waters above the amount the bridge will pass would flow down the North side of the Highway along the downstream grade to some point beyond this property because the State Highway makes a levee that would direct the water.

The project area has natural grasses and willows, shrubs, aspens and cottonwood trees growing along the creek channel. This natural vegetation can be a hindrance to stream flow during flooding conditions, because it can block the stream channels. Some of the higher ground has grasses with some sage brush growing on it.

AW Engineering has calculated the flow that may occur during a typical spring flooding scenario. The information and calculations follow:

Ran NRCS STREAMSTATS PROGRAM

Showed Q = 1580 cfs
Area of runoff 36.15 sq miles

AW experience and knowledge of flood flows in Teton Valley support this data and has run the HEC RAS computer programs based on this data.

EXISTING Bridge Across Hwy 33

Bridge 42 ft wide x 6 high
This bridge under Highway 33 could have a capacity of up to 1580 cfs flowing full. Said bridge data was not put into the HEC RAS program but AW did run two cross Sections on the North side of this bridge for evaluation.

County Bridge Across 2000 West county Road.

The County bridge across 2000 West is 27 feet span inside of Abutments and 4.2 feet high to bottom of girders and is 20 feet wide across the road.
The county road is typically 20 feet wide in this area and has side slopes of 1.5 : 1 along it. The Hec Ras program shows this bridge capacity at 165 cfs. This shows that 1415 cfs will flow down the borrow pit and across the county road way from 100 feet to 1000 feet south of the bridge in the road low areas.

See Appendix Sheets F-1

3- SOUTH LEIGH CREEK INFLUENCE

The County Road slopes to the south from the bridge on Spring Creek for over 1000 feet where it has an incline in elevation to a point above the 100 year flood flow. This high point is a natural small ridge that runs from west to east causing a natural break between the South Leigh drainage and the Spring Creek drainage. This is shown on a USGS Map showing the Western part of the Spring Creek drainage and the South Leigh Creek. AW Engineering ran a cross Section down the County road across South Leigh Creek to verify that these two drainages have a natural separation in the area of County Road 2000 West. *See Map in Appendix Sheet A-2.*

The NRCS Regression program was run and evaluation was done on South Leigh Creek at County road 2000 West. This data, the USGS Map and a review of the lay of the land did not support any conclusion that South Leigh Creek would have a influence upon Spring Creeks 100 year flood flow. Because South Leigh Creek runs south of Spring Creek and with the natural drainage to the west, some irrigation ditches do come off of South Leigh Creek and water the adjacent land. These ditches are very small and would only carry a small amount of water. They have headgates at there point of diversion form South Leigh Creek.

Two small natural drainages come from the area of South Leigh Creek and run onto the said property at the East side. Our topo shots, visual inspection and USGS maps do not indicate that any significant amount of water could flow down these drainages into the Spring Creek drainage.

With this data confirming the USGS Regression data and knowledge of local conditions at this property and the location of Leigh Creek drainage, no further study was done to evaluate any junction with South Leigh Creek for this project.

4- 100 YEAR FLOOD PLAIN MAP

Using the data from the NRCS Regression drainage at the 100 year flow, and running the HEC Ras program with this data the Flood Plain Map was Made showing the 100 year Flood Plain lands. This shows Building Site 2 being outside and above the elevation of the 100 year flood plain. See Appendix Map A-1

Building site 1 is a small island within the flood plain with the land being just above the 100 year flood plain. We have shown this land as being above the Base Flood elevation but within the 100 year Flood Plain.

A statement will be place on the fina Master Plan Plat that will show that any house built within this envelope will have to elevate the area around the house at least 1.0 feet and will possibly be required to get flood plain insurance. This has been discussed with the project owner and developer.

Statement on Master Plat.

"The natural ground for Building Envelope # 1 (BE 1) will be built up 18" above the 6100.53 BFE of this site. A Elevation Certificate will be will be filed with Teton County at building permit application and at final construction of building."

5- CONCLUSIONS

1. The Project map showing the 100 yr flood plain and the BFE's for the two building sites is in *Appendix " A"*.
Calculated flood plain cross sections and data is shown in *Appendix D-F* after imputing the cross sections and running the FEMA Hec-Ras program to calculate the flow area.
See sheets in Appendix E

   The FEMA map panel was made without the aid of on ground or surveyed cross sectional data. Therefore there is some difference in the FEMA 1988 lines and the AW 2010 computed 100 year flood plain lines.

2. There is about 13 acres of this 18 acres parcel of land that is outside of the defined flood plain. Building Site 2 does not lie in the AW Computed 100 year flood plain.
Build Site 1 is a small island that that the elevation is above the 100 year flood plain. This can be built on by filing a elevation certificate, building up the site at least one foot and by getting flood insurance if required or desired.

   The detail topo map of the site along with the pertinent data is shown in the *Appendix " B- G"*.

3. Calculations show the 100 year flood to be 1,580 cfs. This was used to calculated the BFE elevations at the two building sites.
Shown on Appendix B Map

4. The existing bridge at the property inlet across State Highway 33 has a 42 feet span and was not evaluated in this study. However the study was run under the worst case scenario with all of the flood waters coming through this bridge onto the property.

5. The existing bridge at the property outlet across the County road has a 27 feet span and it was included in running the HEC RAS program. The county road and bridge act as a dam across the channel. The cross section along County road 2000 West shows at 700 feet south of the bridge the road elevation drops 3 feet, which would allow the flood flow to cross the county road.

RESPONSE TO WILLIAMS ENGINEERING COMMENTS 3/3/2011

Item 1- We have revised the report and reran data using 1580 cfs.

Item 2- After checking and correcting the data for the road toe and road profile cross sections, (1.70, 1.66 and 1.65 and the bridge sections) the program seemed to run OK.
The data for the Bridge under State Highway 33 was not run in Hec Ras and I feel is now adequately explained in No. 2 -Flood Channel- of the report.

Item 3- The report was revised with all references to data which is not support by the computer program eliminated.

Item 4- The Flood Plain Map was reviewed and lines were checked to see that they agreed with the Hec Ras data.

Item 5-The Containment of Flow. The cross sections were extended to include enough area for flow containment. This was evaluated from survey's and USGS Maps, to impute elevations for the ridge that runs just south of the property and south of AW's detailed survey data.

Item 6- Cross Section Alignment - The cross Sections were reviewed and made as close to actual surveyed lines as possible. We had problems importing a base map or photo to have a good base map for the Hec Ras program, but the Map shown as A-1 is a surveyed and coordinated based map.

Item 7- Limits of Water Shed Map included.

Item 8- South Leigh Creek influence is now a part of AW Engineering's Report No 3 Section.

Item 9- Backwater distance after checking all data at County Road 2000 West bridge now shows backwater at 70 feet using the worst scenario that was run. Three different scenarios (that follow)of private road cross sections was evaluated and are enclosed:

1- As is with not raising the private road elevation.
2- Raising the road elevation +/- 1 foot to be above BFE.
3- Using a centroid of flow for flow line center line.

The worst case scenario (#3 above) was used in the report and mapping data. *See Appendix D:1-2, & E:1*

Item 10- Report revised to Stream stats 1580 cfs.

Item 11- Paragraph about other streams in Teton Co removed.

Item 12- The cross section location and labeling was reviewed and corrections made. All data was changed to be FEMA based elevations.

Item 13- The 6101 Contour line now appears on AW flood plain map, but in rerunning the Hec Ras with the road built up 1 foot from Cross Section 180 west, showed the BFE at Building Envelope 1 was 0.4 feet higher than previous model's shows.

Item 14-Lateral Flow Component We have entered three scenerio's and run them to find the worst condition. The three are

1- Ground as is today with no road work.
2- # 1 with raising road grade 1 foot.
3- # + # 2 and shifting the flow of flood waters to the south to the centroid of the overflow area south of the bank.

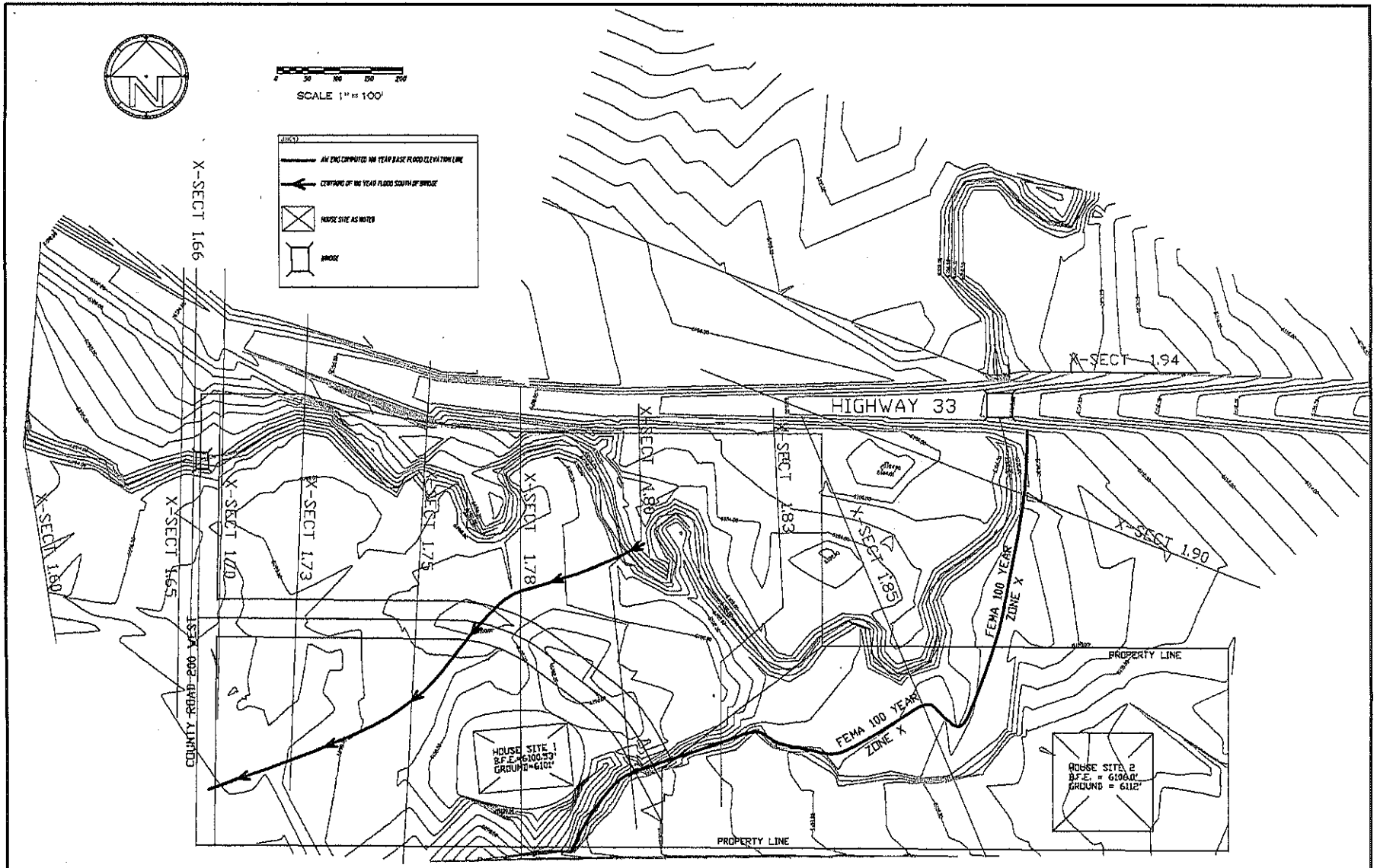
The # 3 scenario is the worst condition for back water and for BFE at Building site 1. It was therefore used in running the final Hec- Ras making the FEMA flood plain map and preparing this report.

Item 15- Island within flood plain. This Island at building Envelope # 1 is shown in the flood plain but is land with elevation above the BFE. This has been discussed with the owner developer and AW will put said language on the Final Plat for public awareness and to have knowledge of conditions of building on said BE # 1.

Item 16- The depth of water over the private drive way into the two homes has been considered by AW Engineering. A phone call to the county engineer has been made for imput on this issue but have not received information yet.
With the 2000 West County road being overtopped by 2.5 feet of water during a 100 year flood and the bridge at 2000 West will probably be washed out the overtopping of the private driveway is a minor concern. Any wise person would get out of the area upon seeing conditions that the 100 year event may happen.

Teton County is not very prone to having flash floods. Flooding occurs during spring snow melt and it typically takes two days to get the high run off down stream from snow melting in the mountains in June. This is the only time that I have seen or have records of significant high stream flow in Teton Valley over the past 60 years.

A-1



PART OF THE S 1/2 NW1/4 SECTION 34
T.6N. R.45E. TETON COUNTY IDAHO

TOPO AS IS 2010
FEMA HEC RAS RAN
WITH NEW ROAD RAISED
+- 1 FOOT.

FLOOD PLAIN STUDY
HERITAGE PEAKS SUBDIVISION

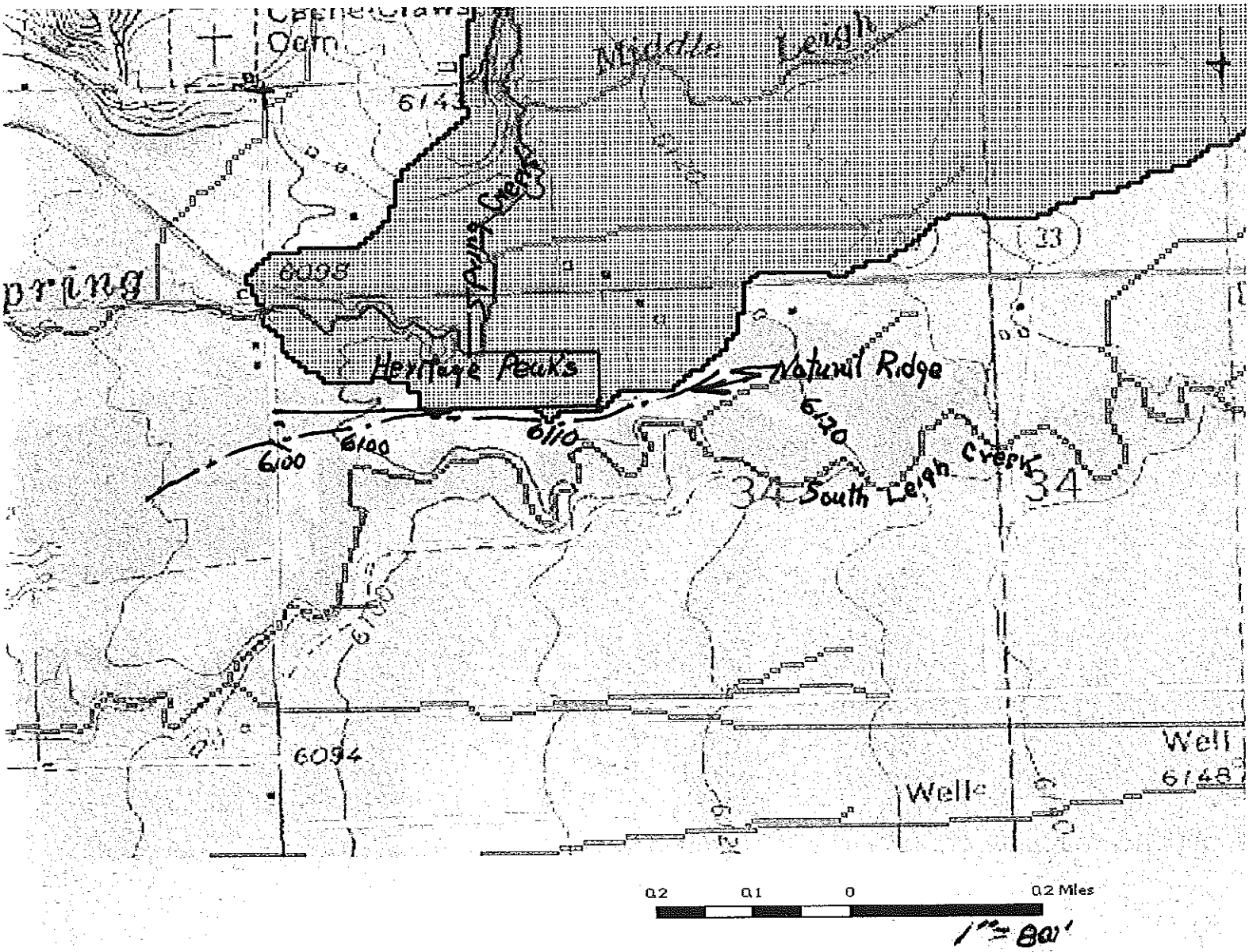
REGINALD ROBERTS
P.O. BOX 417
DRIGGS, IDAHO 83422

AW ENGINEERING

SHEET 1 OF 1

USGS Idaho StreamStats

StreamStats Print Page



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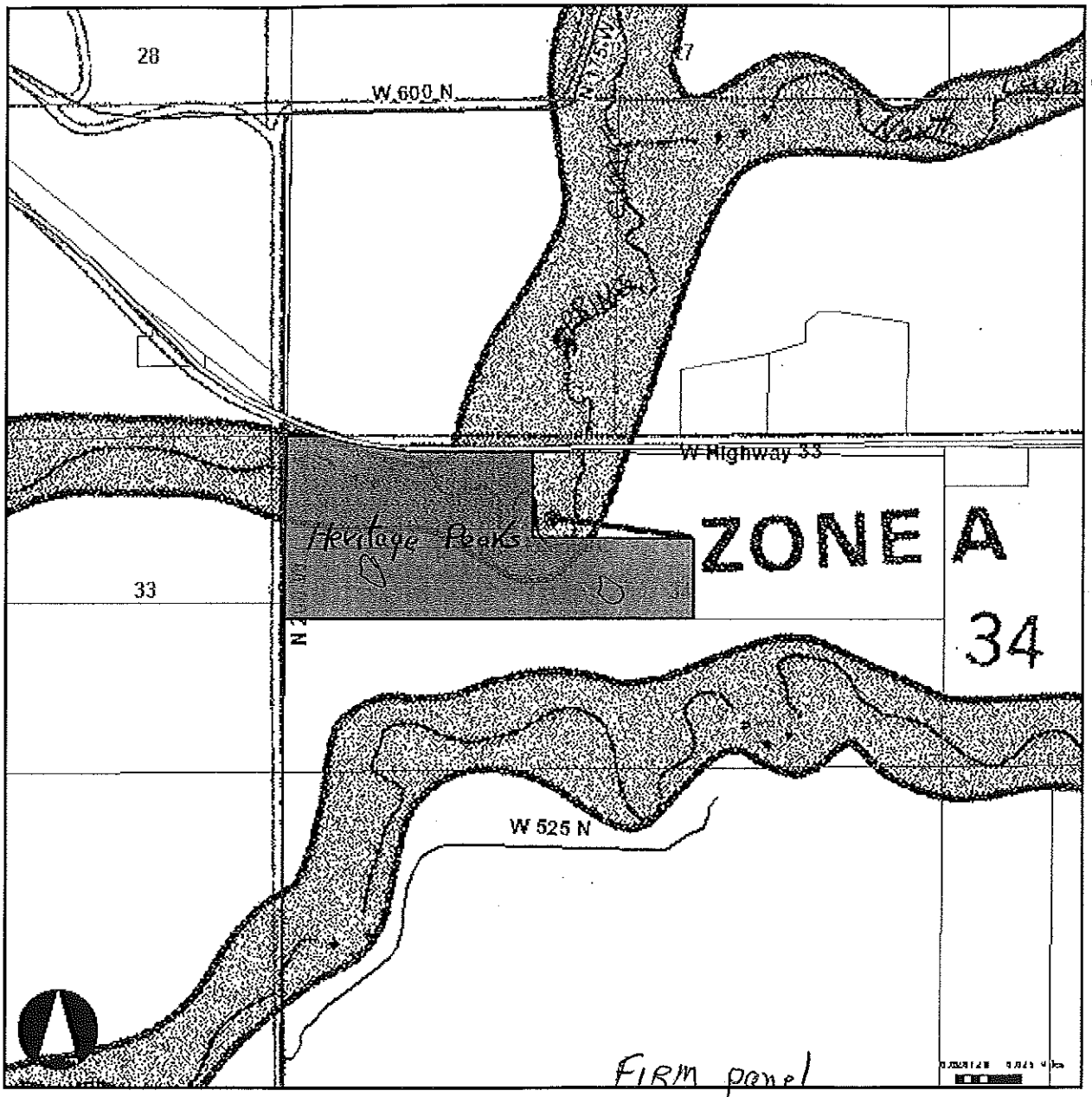
AW Eng
Visual Inspection

FLOOD PLAIN



Parcels

Parcels

Preliminary Subdivisions

Roads

Forest Service

Forest Service

BLM

B.L.M.

State Land

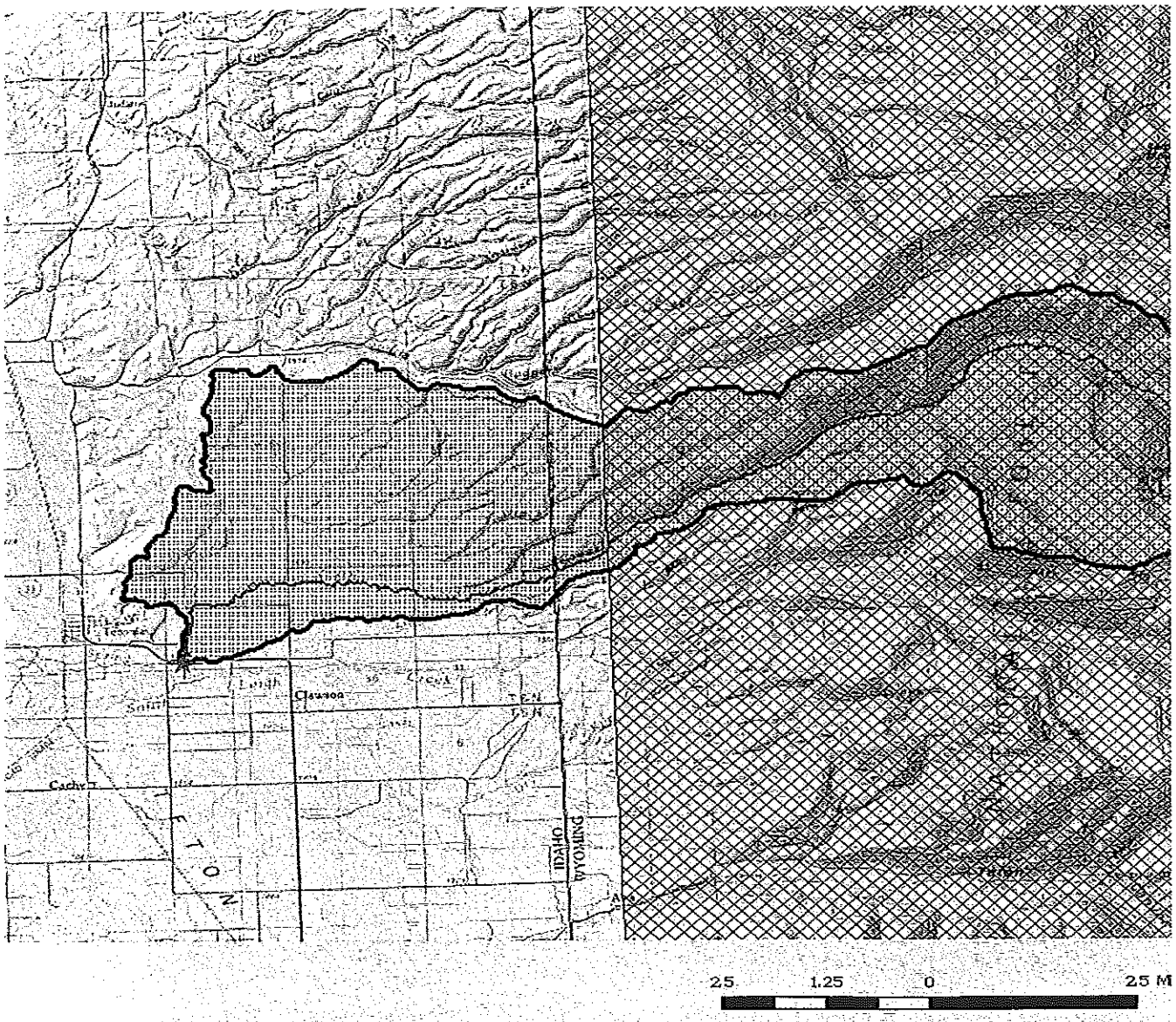
State of Idaho

B–1

USGS Idaho StreamStats

Spring Cr - No Leigh Drainage

Area at Hwy 33 / Spring Cr



2/15/2011 3:30:58 PM 36.2 Sq mi

1580 cfs - 100 yr

C-1

USGS Idaho StreamStats

Streamstats Ungaged Site Report

Date: Tue Mar 1 2011 17:01:49 Mountain Standard Time
Site Location: Idaho
NAD27 Latitude: 43.8066 (43 48 24)
NAD27 Longitude: -111.1353 (-111 08 07)
NAD83 Latitude: 43.8065 (43 48 23)
NAD83 Longitude: -111.1360 (-111 08 10)
Drainage Area: 36.15 mi2
Percent Urban: 0.6 %
Percent Impervious: 0.0602 %

Spring Creek at Hwy 33
Near Tetonia, Idaho
Teton Co.

Peak-Flow Basin Characteristics			
100% Peak Flow Region 8 (36.2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	36.2	2.5	874.8
Mean Basin Slope from 30m DEM (percent)	20.1	5.1	53.6
Slopes gt 30pct from 30m DEM (percent)	22.3	1.2	88.7

Low-Flow Basin Characteristics			
100% Low Flow Region 8 (36.2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	36.2	6.6	874.8
Percent Forest (percent)	37	2.3	93.9
Mean Annual Precipitation (inches)	32.7	14.2	56
Mean Basin Elevation (feet)	7290	5691.9	8951
Mean Basin Slope from 30m DEM (percent)	20.1	6.15	53.2
Slopes gt 30pct from 30m DEM (percent)	22.3	1.2	86.6

Zero-Flow Probability Basin Characteristics
100% Undefined Region (36.15 mi2)

The selected watershed is entirely in an area for which flow equations were not defined.

Monthly and Annual Basin Characteristics			
100% Low Flow Region 8 (36.2 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	36.2	6.6	874.8

Percent Forest (percent)	37	2.3	93.9
Mean Annual Precipitation (inches)	32.7	14.2	56
Mean Basin Elevation (feet)	7290	5691.9	8951
Mean Basin Slope from 30m DEM (percent)	20.1	6.15	53.2
Slopes gt 30pct from 30m DEM (percent)	22.3	1.2	86.6

Peak-Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_5	195	74		64.9	583
PK2	234	69		82.5	665
PK2_33	258	68		92.4	718
PK5	336	64		126	895
PK10	399	63		152	1050
PK25	473	63		180	1240
PK50	522	64		198	1380
PK100	591	64		222	1580
PK200	642	65		237	1730
PK500	690	67		251	1900

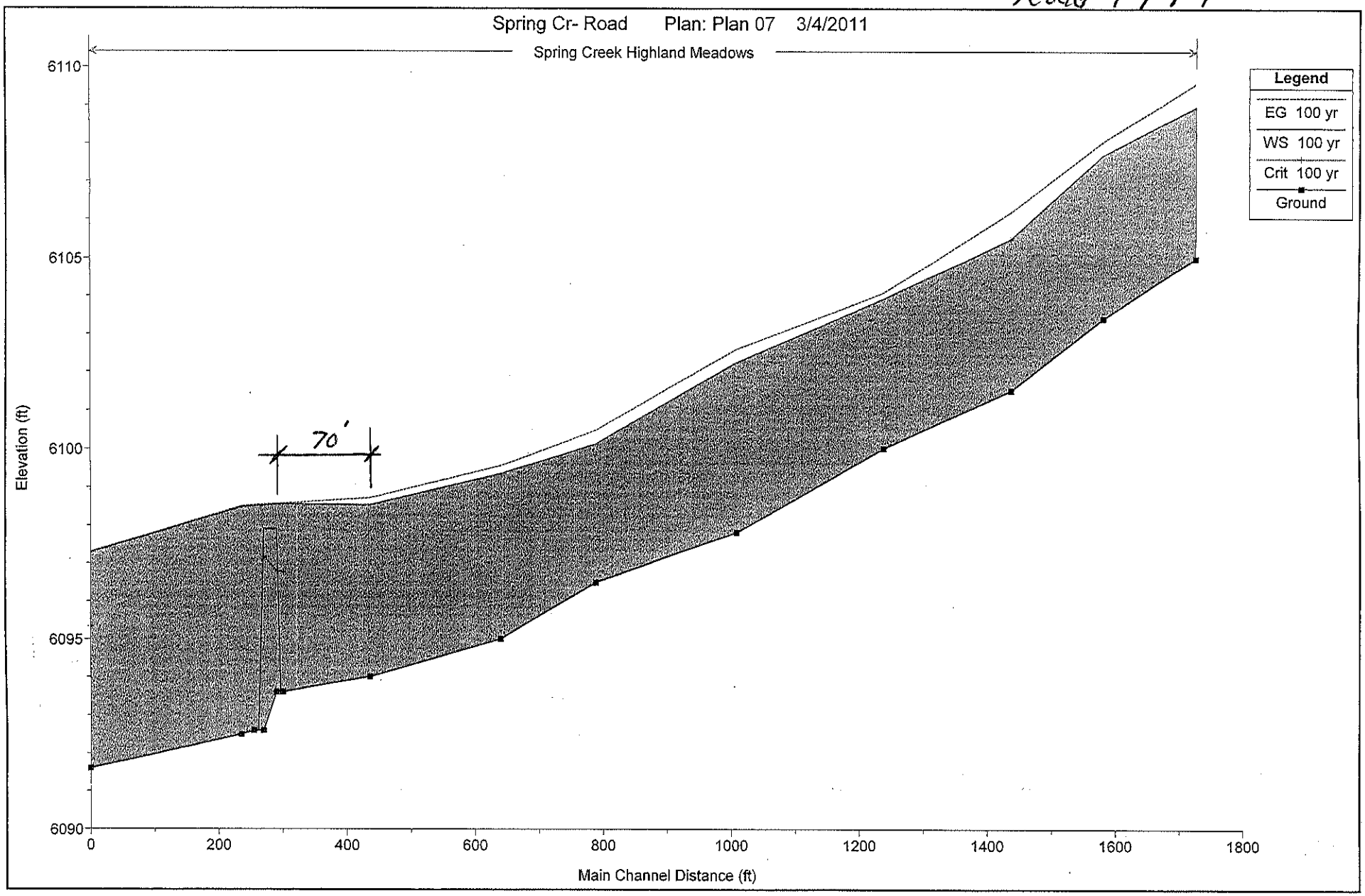
Low-Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
M1D10Y	10.3	49			
M7D10Y	11.3	29			
M7D2Y	15.5	32			
M30D5Y	14.3	28			

Monthly and Annual Streamflow Statistics

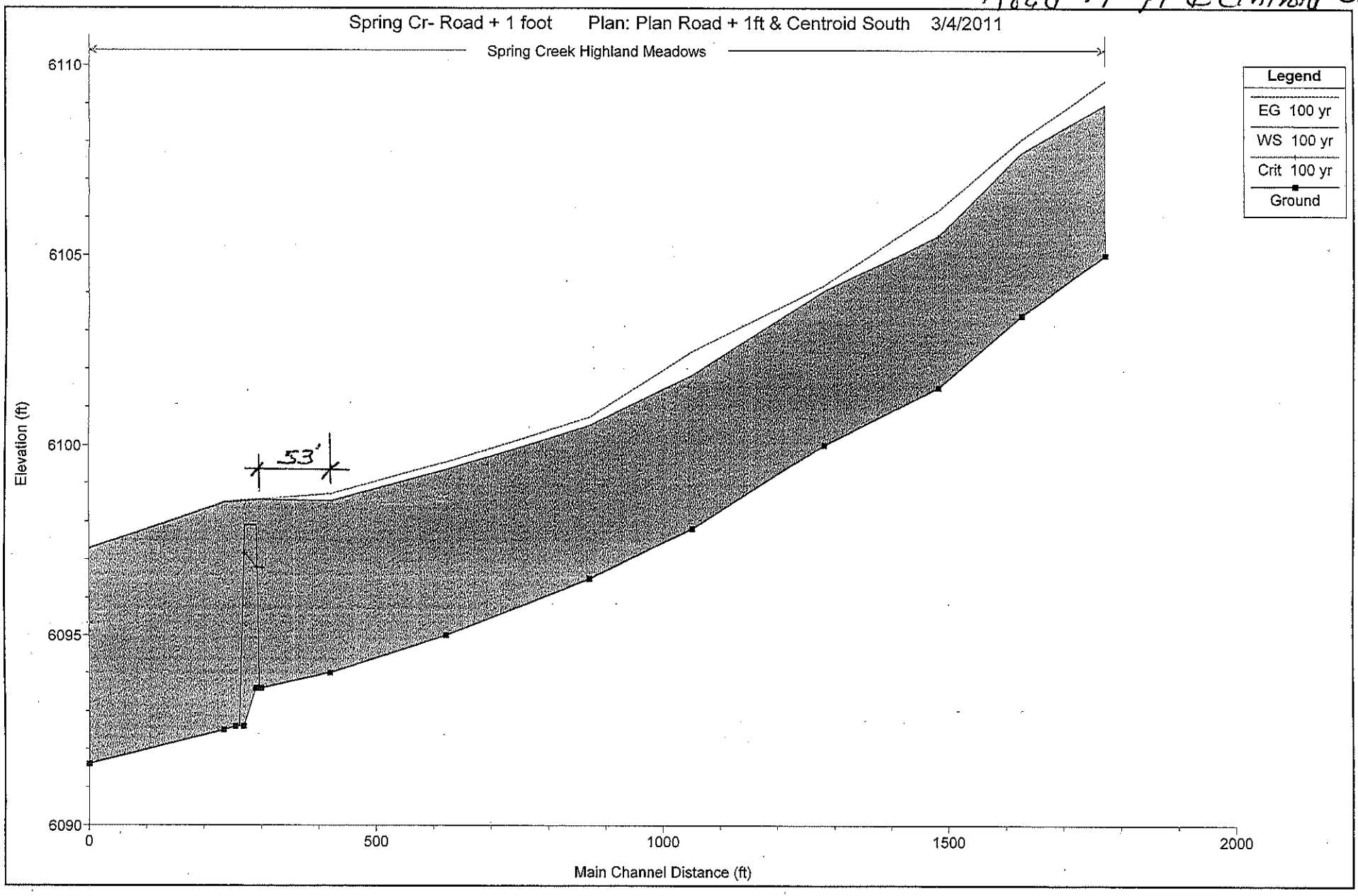
Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
QA	53.9	50			
JAND20	27.8	67			
JAND50	22.4	75			
JAND80	17.6	86			
FEBD20	27.8	67			
FEBD50	21.8	74			

Road + 1 FT


Spring Cr- Road Plan: Plan 07 3/4/2011
Spring Creek Highland Meadows
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
70'
Elevation (ft)
6110
6105
6100
6095
6090
0
200
400
600
800
1000
1200
1400
1600
1800
Main Channel Distance (ft)

D-1

Road +1 ft & Centroid South



HEC-RAS Plan: Rd +1' & Centroi River: Spring Creek Reach: Highland Meadows Profile: 100 yr

Road Raised + 1° FT & Centroid Flow

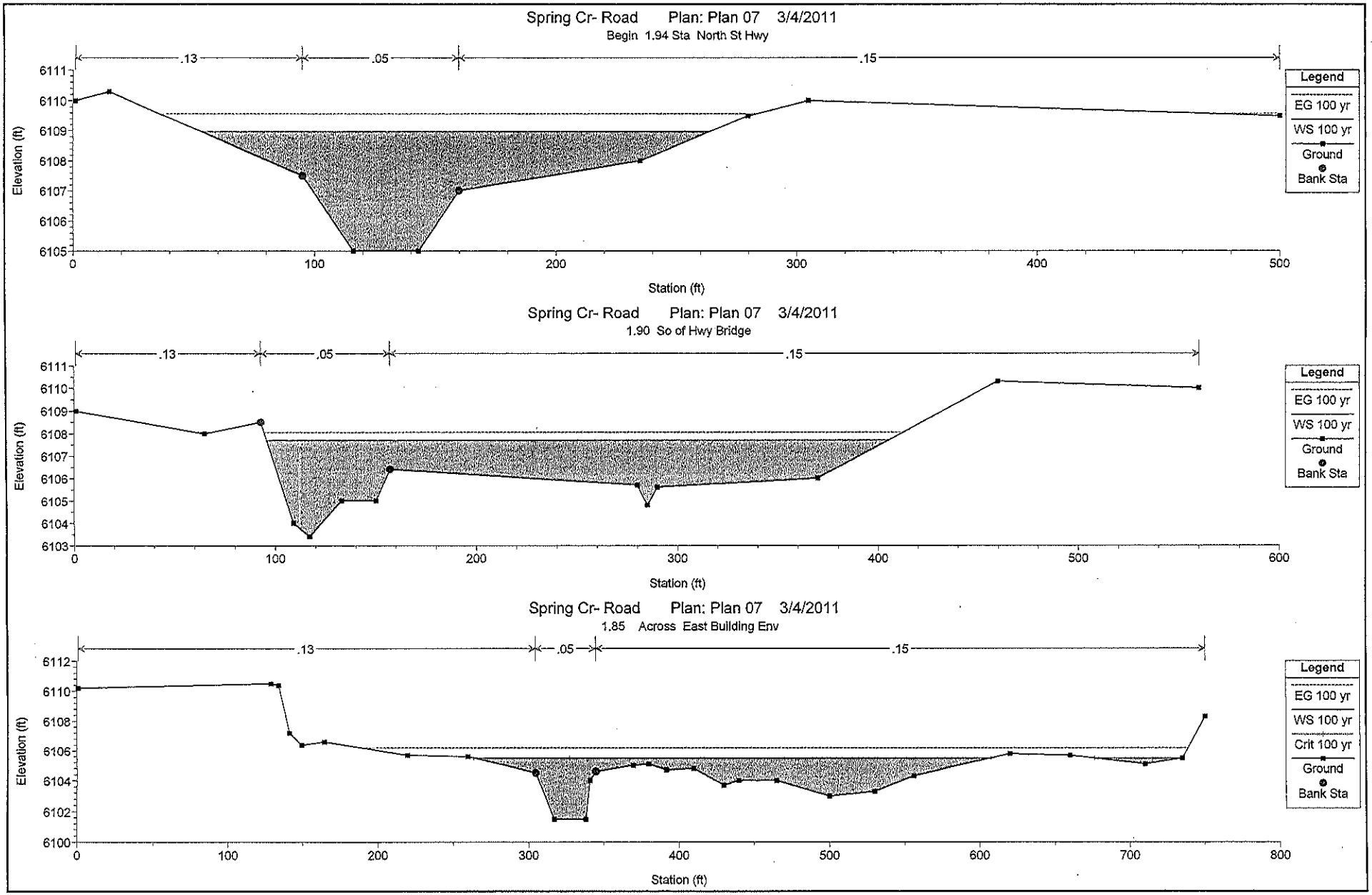
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Highland Meadows	1.94	100 yr	1580.00	6105.00	6108.97		6109.57	0.010034	6.58	369.46	210.94	0.64
Highland Meadows	1.90	100 yr	1580.00	6103.40	6107.70		6108.06	0.009961	5.87	583.29	309.83	0.62
Highland Meadows	1.85	100 yr	1580.00	6101.50	6105.51	6105.51	6106.20	0.016855	8.17	498.46	402.36	0.81
Highland Meadows	1.83	100 yr	1580.00	6100.00	6104.06		6104.20	0.004127	4.35	801.03	369.53	0.41
Highland Meadows	1.80	100 yr	1580.00	6097.80	6101.85		6102.46	0.018097	8.08	484.67	358.63	0.82
Highland Meadows	1.78	100 yr	1580.00	6096.50	6100.53		6100.74	0.005952	5.13	761.52	431.14	0.49
Highland Meadows	1.75	100 yr	1580.00	6095.00	6099.35		6099.55	0.003835	4.43	953.09	707.95	0.40
Highland Meadows	1.73	100 yr	1580.00	6094.00	6098.53		6098.71	0.004525	4.73	1045.62	737.10	0.43
Highland Meadows	1.70	100 yr	1580.00	6093.60	6098.57	6096.78	6098.58	0.000261	1.50	2308.87	1193.65	0.13
Highland Meadows	1.68		Bridge									
Highland Meadows	1.66	100 yr	1580.00	6092.60	6098.51		6098.54	0.000582	2.40	2602.01	1218.57	0.20
Highland Meadows	1.65	100 yr	1580.00	6092.50	6098.49		6098.51	0.004458	0.59	1679.25	836.08	0.04
Highland Meadows	1.60	100 yr	1580.00	6091.60	6097.29	6095.33	6097.30	0.006106	0.67	1604.62	850.00	0.05

HEC-RAS Plan: Road as Is River: Spring Creek Reach: Highland Meadows Profile: 100 yr

As is Top - 2010

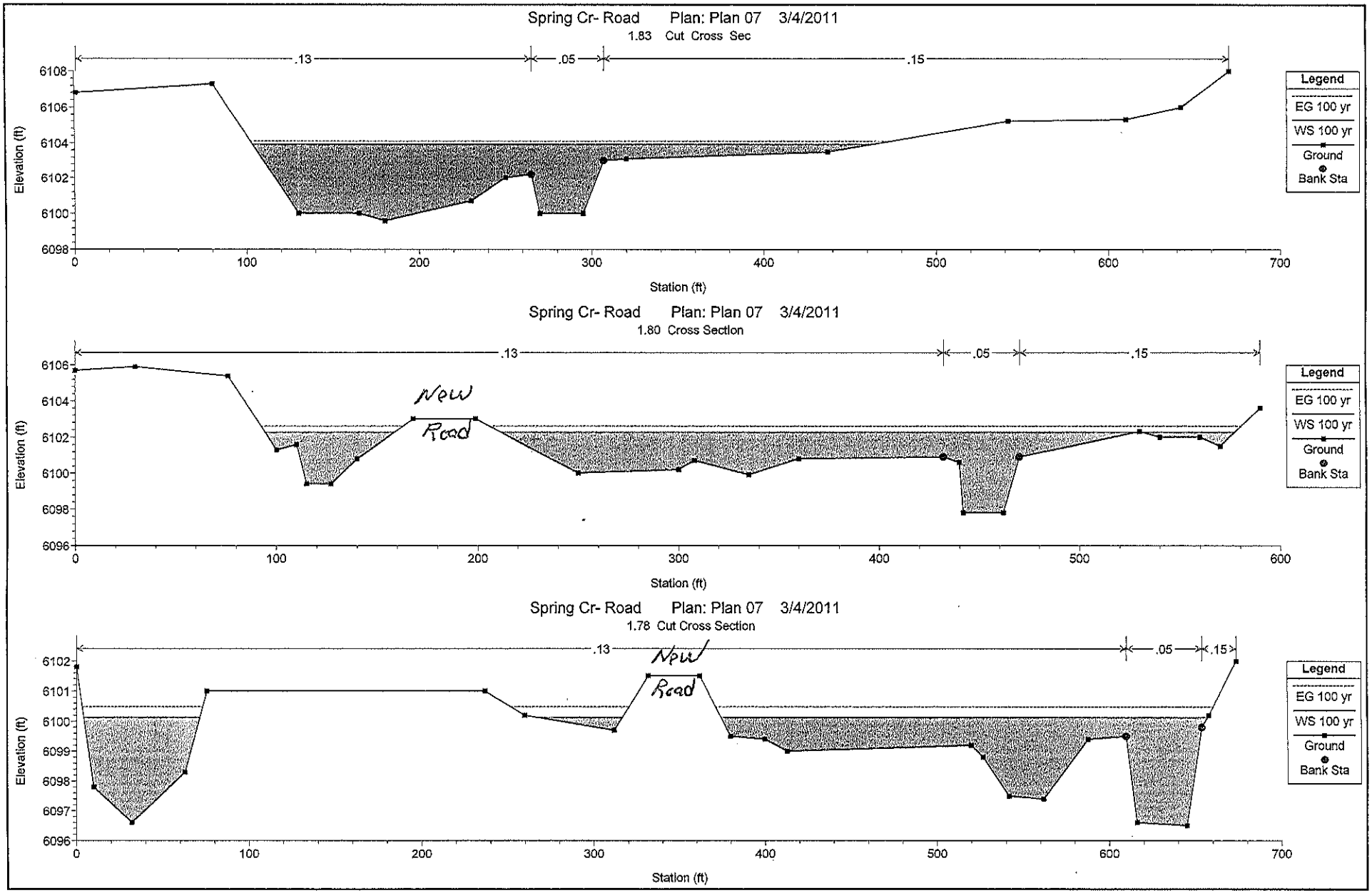
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Highland Meadows	1.94	100 yr	1580.00	6105.00	6108.97		6109.57	0.010034	6.58	369.46	210.94	0.64
Highland Meadows	1.90	100 yr	1580.00	6103.40	6107.70		6108.06	0.009961	5.87	583.29	309.83	0.62
Highland Meadows	1.85	100 yr	1580.00	6101.50	6105.51	6105.51	6106.20	0.016855	8.17	498.46	402.36	0.81
Highland Meadows	1.83	100 yr	1580.00	6100.00	6103.93		6104.09	0.004740	4.54	754.32	360.75	0.44
Highland Meadows	1.80	100 yr	1580.00	6097.80	6102.25		6102.60	0.009553	6.38	645.15	425.97	0.61
Highland Meadows	1.78	100 yr	1580.00	6096.50	6100.14		6100.48	0.010450	6.28	600.00	401.31	0.63
Highland Meadows	1.75	100 yr	1580.00	6095.00	6099.33		6099.54	0.003977	4.50	952.04	745.54	0.41
Highland Meadows	1.73	100 yr	1580.00	6094.00	6098.55		6098.71	0.004125	4.53	1091.20	737.59	0.41
Highland Meadows	1.70	100 yr	1580.00	6093.60	6098.57	6096.79	6098.58	0.000249	1.47	2344.85	1193.71	0.13
Highland Meadows	1.68		Bridge									
Highland Meadows	1.66	100 yr	1580.00	6092.60	6098.51		6098.54	0.000582	2.40	2602.01	1218.57	0.20
Highland Meadows	1.65	100 yr	1580.00	6092.50	6098.49		6098.51	0.004458	0.59	1679.25	836.08	0.04
Highland Meadows	1.60	100 yr	1580.00	6091.60	6097.29	6095.33	6097.30	0.006106	0.67	1604.62	850.00	0.05

E-1


Spring Cr- Road Plan: Plan 07 3/4/2011
Begin 1.94 Sta North St Hwy
.13
.05
.15
Elevation (ft)
Station (ft)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Spring Cr- Road Plan: Plan 07 3/4/2011
1.90 So of Hwy Bridge
.13
.05
.15
Elevation (ft)
Station (ft)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Spring Cr- Road Plan: Plan 07 3/4/2011
1.85 Across East Building Env
.13
.05
.15
Elevation (ft)
Station (ft)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta

E-2

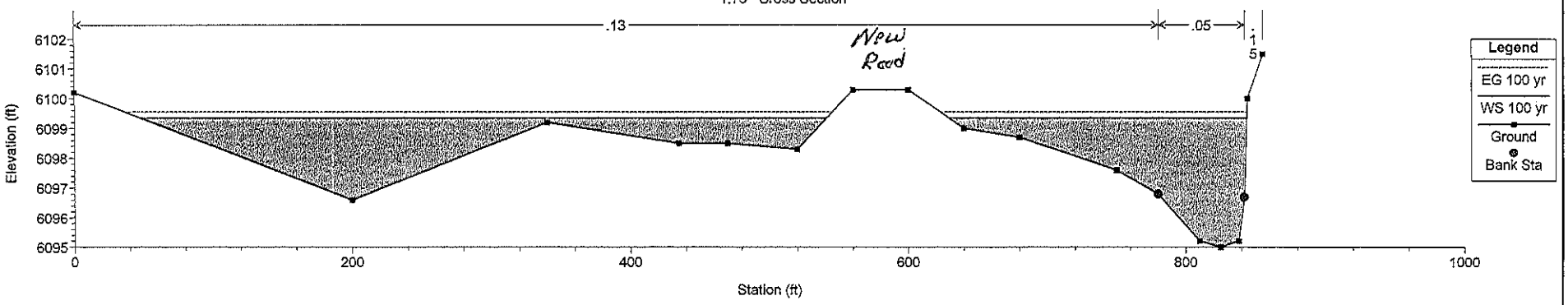
E-2


Spring Cr- Road Plan: Plan 07 3/4/2011
1.83 Cut Cross Sec
.13
.05
.15
Elevation (ft)
Station (ft)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Spring Cr- Road Plan: Plan 07 3/4/2011
1.80 Cross Section
New Road
Spring Cr- Road Plan: Plan 07 3/4/2011
1.78 Cut Cross Section

E-3

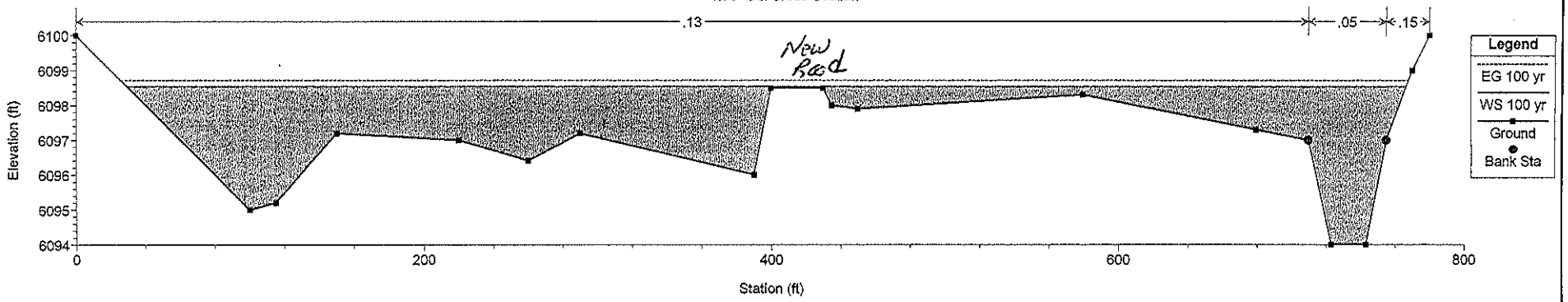
Spring Cr- Road Plan: Plan 07 3/4/2011

1.75 Cross Section



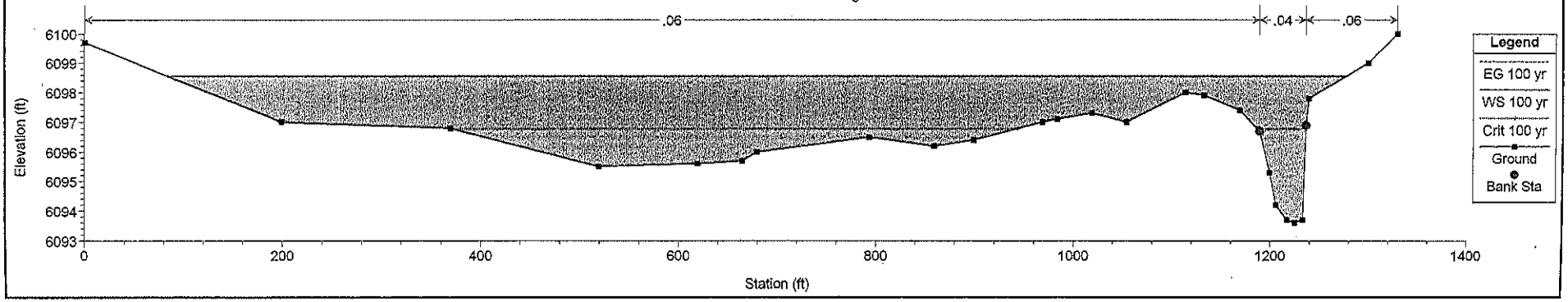
Spring Cr- Road Plan: Plan 07 3/4/2011

1.73 Cut Cross Section



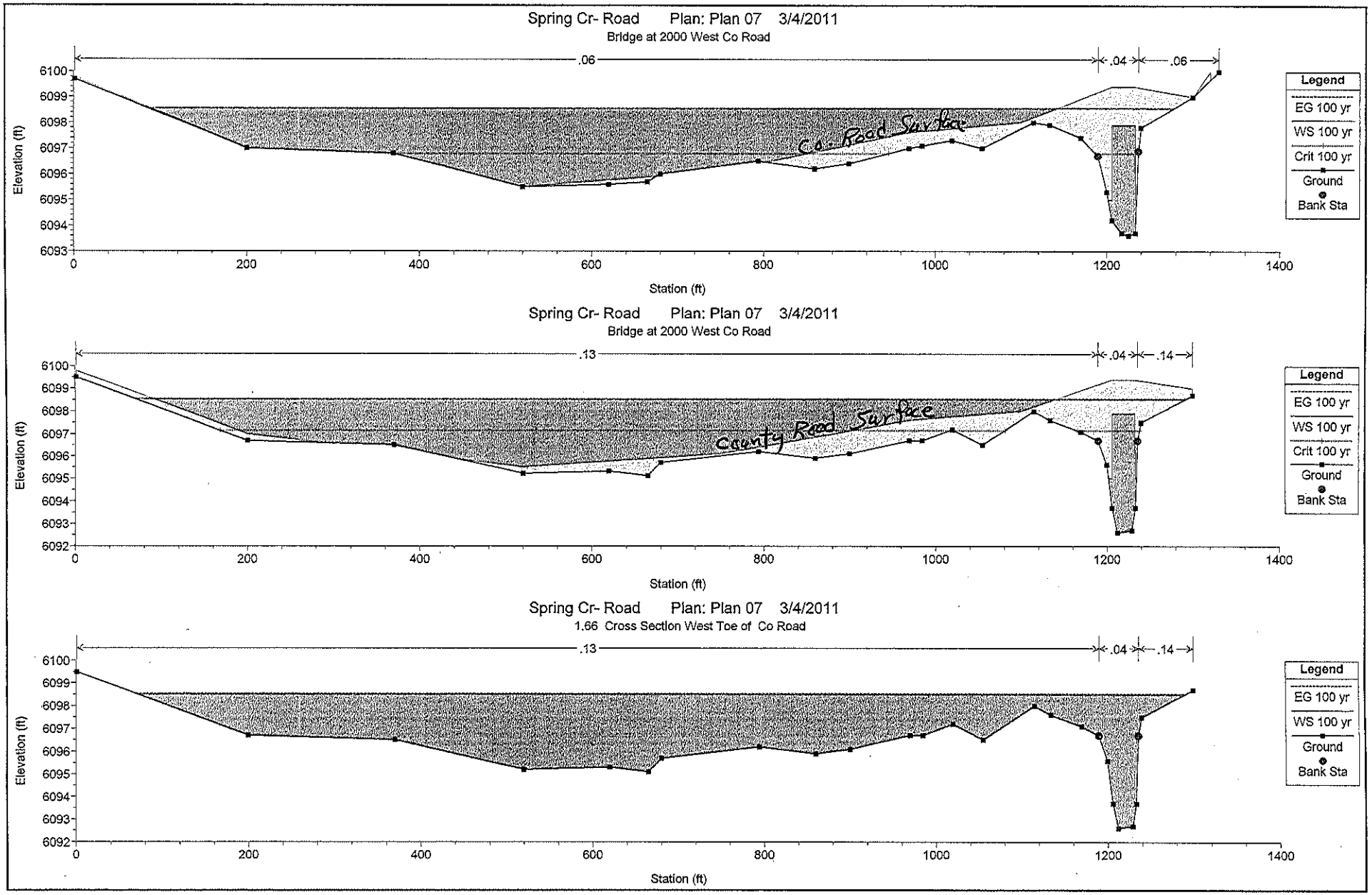
Spring Cr- Road Plan: Plan 07 3/4/2011

1.70 Cross Section East of Bridge Co Road



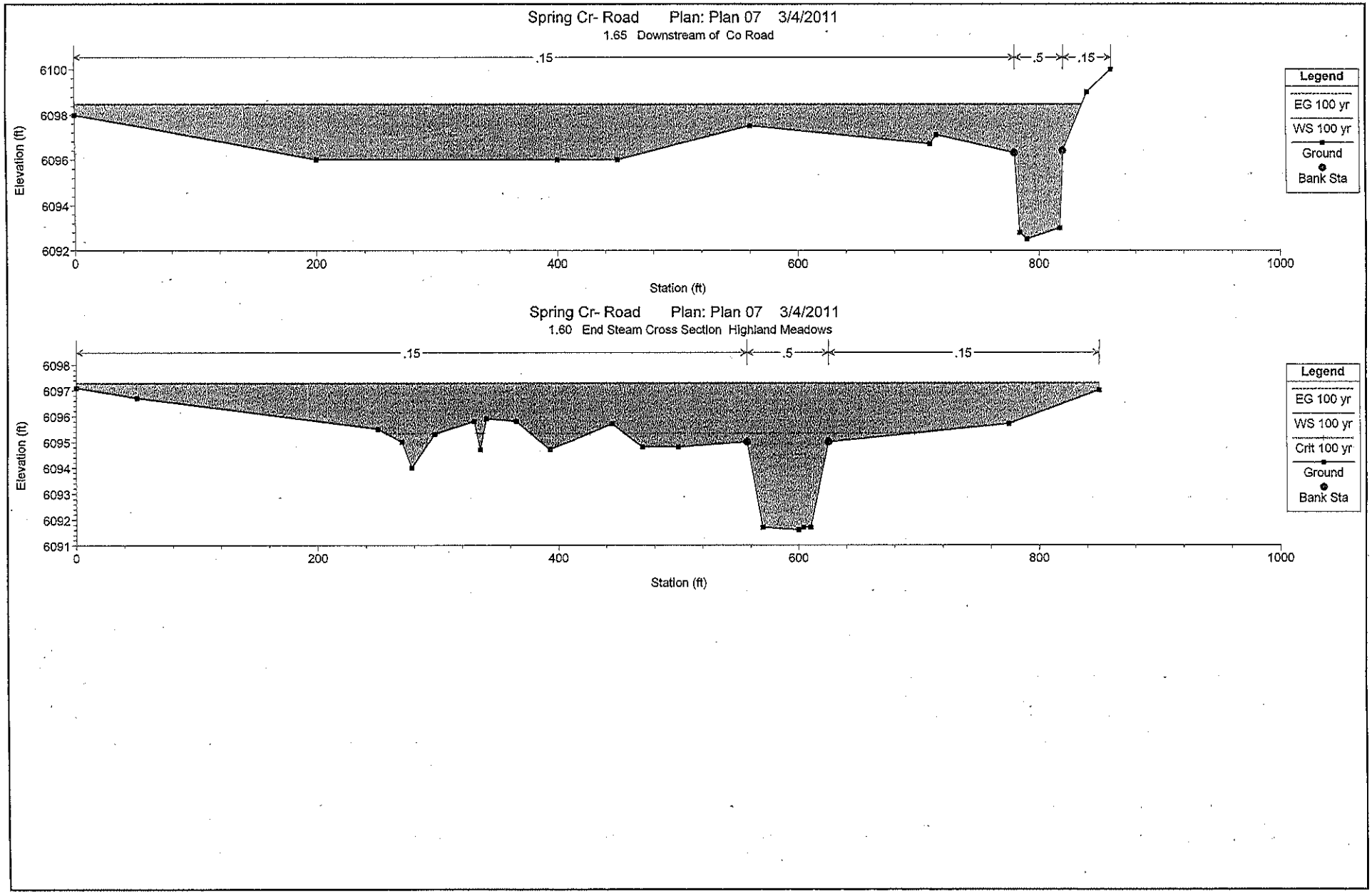
E-4

E-4


Spring Cr- Road Plan: Plan 07 3/4/2011
Bridge at 2000 West Co Road
.06
.04
.06
Co. Road Surface
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Spring Cr- Road Plan: Plan 07 3/4/2011
Bridge at 2000 West Co Road
.13
.04
.14
County Road Surface
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Spring Cr- Road Plan: Plan 07 3/4/2011
1.66 Cross Section West Toe of Co Road
.13
.04
.14
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

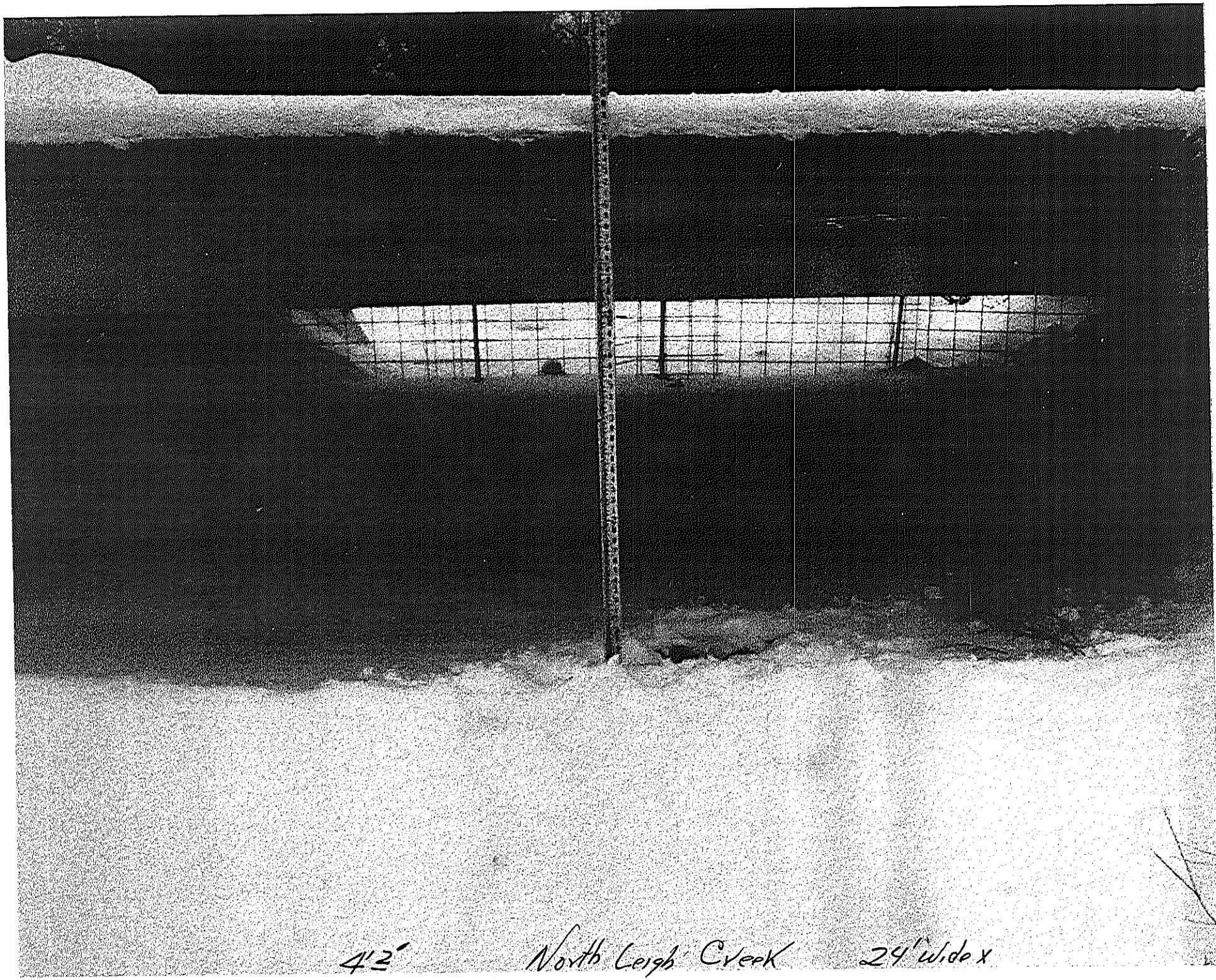
E-5

E-5


Spring Cr- Road Plan: Plan 07 3/4/2011
1.65 Downstream of Co Road
.15
.5
.15
Elevation (ft)
6100
6098
6096
6094
6092
0
200
400
600
800
1000
Station (ft)
Legend
EG 100 yr
WS 100 yr
Ground
Bank Sta
Spring Cr- Road Plan: Plan 07 3/4/2011
1.60 End Steam Cross Section Highland Meadows
.15
.5
.15
Elevation (ft)
6098
6097
6096
6095
6094
6093
6092
6091
0
200
400
600
800
1000
Station (ft)
Legend
EG 100 yr
WS 100 yr
Crit 100 yr
Ground
Bank Sta

E-6

E-6



G-1

G-2

Spring Creek
County Bridge - Looking East

G-3

Spring Creek
State Hwy 33 - Looking South

G: 2 of 2

NOTE: THIS IS A REPRODUCTION OF TABLE I, APPENDIX A,
"DESIGN CHARTS FOR OPEN CHANNEL FLOW", (HDS #3)

	Manning's n range [1]
I. Closed conduits:	
A. Concrete pipe	0.011–0.013
B. Corrugated-metal pipe or pipe-arch:	
1. 2⅔ by ½-in. corrugation (riveted pipe): [3]	
a. Plain or fully coated	0.024
b. Paved invert (range values are for 25 and 60 percent of circumference paved):	
(1) Flow full depth	0.021–0.018
(2) Flow 0.8 depth	0.021–0.016
(3) Flow 0.6 depth	0.019–0.013
2. 6 by 2-in. corrugation (field bolted)	0.03
C. Vitrified clay pipe	0.012–0.014
D. Cast-iron pipe, uncoated	0.013
E. Steel pipe	0.009–0.011
F. Brick	0.014–0.017
G. Monolithic concrete:	
1. Wood forms, rough	0.015–0.017
2. Wood forms, smooth	0.012–0.014
3. Steel forms	0.012–0.013
H. Cemented rubble masonry walls:	
1. Concrete floor and top	0.017–0.022
2. Natural floor	0.019–0.025
I. Laminated treated wood	0.015–0.017
J. Vitrified clay liner plates	0.015
II. Open channels, lined [4] (straight alinement): [5]	
A. Concrete, with surfaces as indicated:	
1. Formed, no finish	0.013–0.017
2. Trowel finish	0.012–0.014
3. Float finish	0.013–0.015
4. Float finish, some gravel on bottom	0.015–0.017
5. Gunite, good section	0.016–0.019
6. Gunite, wavy section	0.018–0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015–0.017
2. Random stone in mortar	0.017–0.020
3. Cement rubble masonry	0.020–0.025
4. Cement rubble masonry, plastered	0.016–0.020
5. Dry rubble (riprap)	0.020–0.030
C. Gravel bottom, sides as indicated:	
1. Formed concrete	0.017–0.020
2. Random stone in mortar	0.020–0.023
3. Dry rubble (riprap)	0.023–0.033
D. Brick	0.014–0.017
E. Asphalt:	
1. Smooth	0.013
2. Rough	0.016
F. Wood, planed, clean	0.011–0.013
G. Concrete-lined excavated rock:	
1. Good section	0.017–0.020
2. Irregular section	0.022–0.027
III. Open channels, excavated [6] (straight alinement, [7] natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016–0.018
2. Clean, after weathering	0.018–0.020
3. With short grass, few weeds	0.022–0.027
4. In gravelly soil, uniform section, clean	0.022–0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022–0.025
2. Grass, some weeds	0.025–0.030
3. Dense weeds or aquatic plants in deep channels	0.030–0.035
4. Sides clean, gravel bottom	0.025–0.030
5. Sides clean, cobble bottom	0.030–0.040
C. Dragline excavated or dredged:	
1. No vegetation	0.028–0.033
2. Light brush on banks	0.035–0.050
D. Rock:	
1. Based on design section	0.035
2. Based on actual mean section:	
a. Smooth and uniform	0.035–0.040
b. Jagged and irregular	0.040–0.045
E. Channels not maintained, weeds and brush uncut:	
1. Dense weeds, high as flow depth	0.08–0.12
2. Clean bottom, brush on sides	0.05–0.08
3. Clean bottom, brush on sides, highest stage of flow	0.07–0.11
4. Dense brush, high stage	0.10–0.14
IV. Highway channels and swales with maintained vegetation [8] (values shown are for velocities of 2 and 6 f.p.s.):	
A. Depth of flow up to 0.7 foot:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.07–0.045
b. Length 4–6 inches	0.09–0.05
2. Good stand, any grass:	
a. Length about 12 inches	0.18–0.09
b. Length about 24 inches	0.30–0.15
3. Fair stand, any grass:	
a. Length about 12 inches	0.14–0.08
b. Length about 24 inches	0.25–0.13
B. Depth of flow 0.7–1.5 feet:	
1. Bermudagrass, Kentucky bluegrass, buffalograss:	
a. Mowed to 2 inches	0.05–0.035
b. Length 4 to 6 inches	0.06–0.04
2. Good stand, any grass:	
a. Length about 12 inches	0.12–0.07
b. Length about 24 inches	0.20–0.10
3. Fair stand, any grass:	
a. Length about 12 inches	0.10–0.06
b. Length about 24 inches	0.17–0.09
V. Street and expressway gutters:	
A. Concrete gutter, troweled finish	0.012
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement:	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.016
E. For gutters with small slope, where sediment may accumulate, increase above values of n by	*0.002*
VI. Natural stream channels: [9]	
A. Minor streams [4] (surface width at flood stage less than 100 ft.):	
1. Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030–0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035–0.05
c. Some weeds, light brush on banks	0.035–0.05
d. Some weeds, heavy brush on banks	0.05–0.07
e. Some weeds, dense willows on banks	0.06–0.08
f. For trees within channel, with branches submerged at high stage, increase all above values by	*0.01–0.01*
2. Irregular sections, with pools, slight channel meander; increase values given in 1a–e about	*0.01–0.01*
3. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage:	
a. Bottom of gravel, cobbles, and few boulders	0.04–0.05
b. Bottom of cobbles, with large boulders	0.05–0.07
B. Flood plains (adjacent to natural streams):	
1. Pasture, no brush:	
a. Short grass	0.030–0.035
b. High grass	0.035–0.05
2. Cultivated areas:	
a. No crop	0.03–0.04
b. Mature row crops	0.035–0.045
c. Mature field crops	0.04–0.05
3. Heavy weeds, scattered brush	0.05–0.07
4. Light brush and trees: [10]	
a. Winter	0.05–0.06
b. Summer	0.06–0.08
5. Medium to dense brush: [10]	
a. Winter	0.07–0.11
b. Summer	0.10–0.16
6. Dense willows, summer, not bent over by current	0.15–0.20
7. Cleared land with tree stumps, 100–150 per acre:	
a. No sprouts	0.04–0.05
b. With heavy growth of sprouts	0.06–0.08
8. Heavy stand of timber, a few down trees, little undergrowth:	
a. Flood depth below branches	0.10–0.12
b. Flood depth reaches branches	0.12–0.16
C. Major streams (surface width at flood stage more than 100 ft.): Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of n may be somewhat reduced. Follow recommendation in publication cited [4] if possible. The value of n for larger streams of most regular section, with no boulders or brush, may be in the range of	0.028–0.033

TYPICAL MANNING BASE "n" VALUES | TABLE "F-1a"

Streamstats Ungaged Site Report

Date: Fri Feb 4 2011 10:42:42 Mountain Standard Time
Site Location: Idaho
NAD27 Latitude: 43.8037 (43 48 13)
NAD27 Longitude: -111.1355 (-111 08 08)
NAD83 Latitude: 43.8036 (43 48 13)
NAD83 Longitude: -111.1363 (-111 08 11)
Drainage Area: 23.76 mi2
Percent Urban: 1.11 %
Percent Impervious: 0.0817 %

South Leigh Creek

100% Peak Flow Region 8 (23.8 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	23.8	2.5	874.8
Mean Basin Slope from 30m DEM (percent)	27.5	5.1	53.6
Slopes gt 30pct from 30m DEM (percent)	35.8	1.2	88.7

100% Low Flow Region 8 (23.8 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	23.8	6.6	874.8
Percent Forest (percent)	37	2.3	93.9
Mean Annual Precipitation (inches)	41.7	14.2	56
Mean Basin Elevation (feet)	7920	5691.9	8951
Mean Basin Slope from 30m DEM (percent)	27.5	6.15	53.2
Slopes gt 30pct from 30m DEM (percent)	35.8	1.2	86.6

100% Undefined Region (23.76 mi2)

The selected watershed is entirely in an area for which flow equations were not defined.

I-1

100% Low Flow Region 8 (23.8 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	23.8	6.6	874.8
Percent Forest (percent)	37	2.3	93.9
Mean Annual Precipitation (inches)	41.7	14.2	56
Mean Basin Elevation (feet)	7920	5691.9	8951
Mean Basin Slope from 30m DEM (percent)	27.5	6.15	53.2
Slopes gt 30pct from 30m DEM (percent)	35.8	1.2	86.6

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK1_5	146	74		48.8	438
PK2	175	69		61.6	497
PK2_33	192	68		69	536
PK5	249	64		93.6	664
PK10	296	63		112	777
PK25	349	63		133	918
PK50	385	63		145	1020
PK100	436	64		163	1160
PK200	473	65		175	1280
PK500	507	67		184	1400

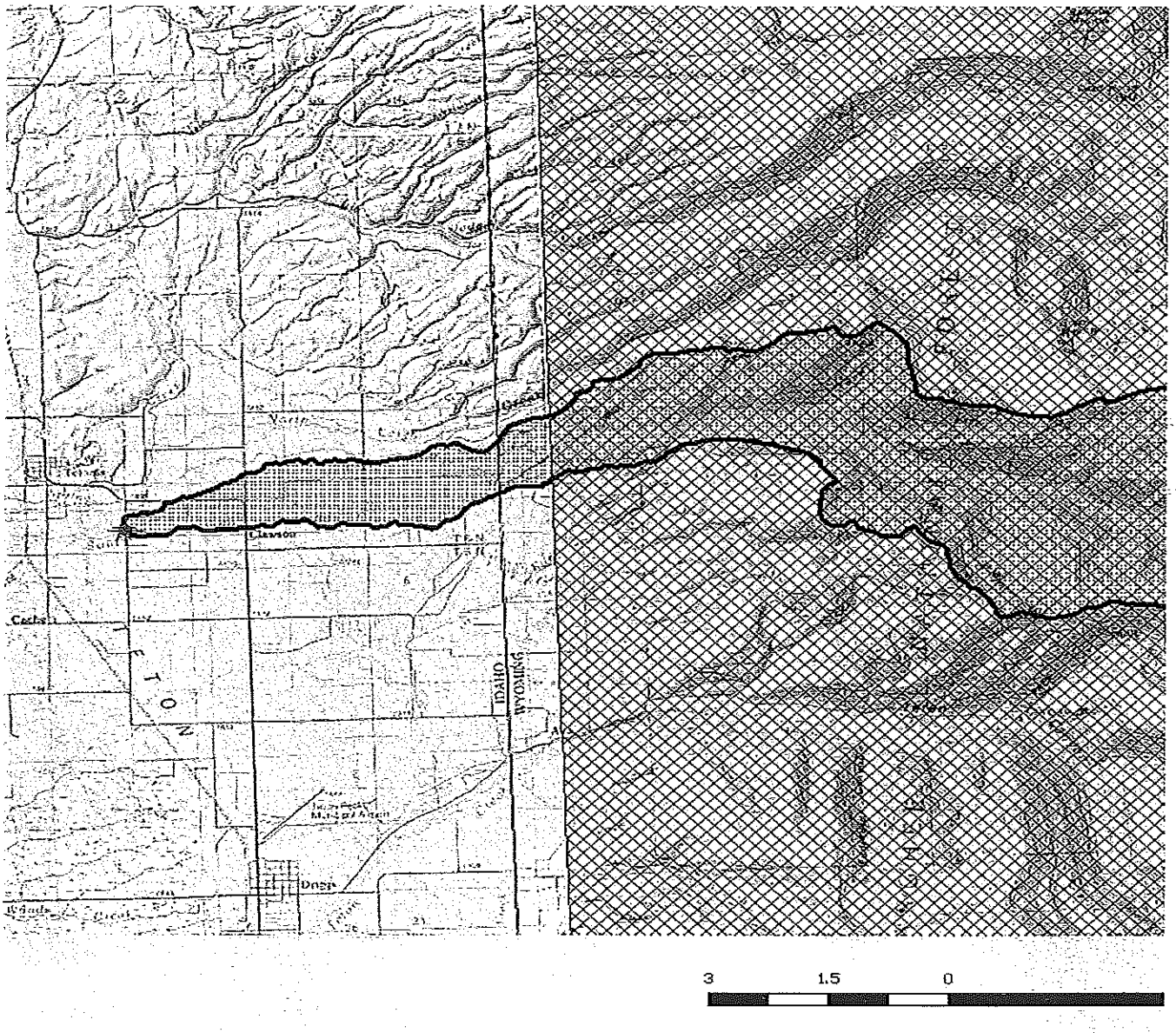
Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
M1D10Y	5.87	49			
M7D10Y	6.52	29			
M7D2Y	8.58	32			
M30D5Y	7.39	28			

Statistic	Flow (ft^3/s)	Estimation Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum

USGS Idaho StreamStats

StreamStats Print Page

South Leigh Creek



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I–3